

**WHAT IS CLAIMED IS:**

1           1. A power train for a motor vehicle, said power train  
2 comprising a combustion engine with a driving shaft turning at a  
3 first rpm rate, at least one torque-coupling device, a  
4 transmission with a transmission input shaft, and at least one  
5 electro-mechanical energy converter with a stator and with a  
6 rotor and an energy-converter shaft turning at a second rpm  
7 rate, said electro-mechanical energy converter being operable at  
8 least as a motor and as a generator and having an interactive  
9 rotary connection to the driving shaft; wherein the interactive  
10 rotary connection has at least two rpm ratios defined as  
11 quotients of the first rpm rate divided by the second rpm rate,  
12 and wherein the at least two rpm ratios automatically set  
13 themselves according to which of at least two operating modes  
14 the electro-mechanical energy converter is working in, said at  
15 least two operating modes comprising a start-up mode and a  
16 driving mode; wherein under a first mode of the at least two  
17 operating modes the torque flows from the electro-mechanical  
18 energy converter to the combustion engine, and under a second  
19 mode of the at least two operating modes the torque flows from  
20 the combustion engine to the electro-mechanical energy  
21 converter; wherein the interactive rotary connection comprises

22 at least one rotary transfer device arranged between the  
23 electro-mechanical energy converter and the combustion engine;  
24 and wherein the at least one rotary transfer device comprises a  
25 planetary gear mechanism with at least one ring gear, at least  
26 one sun gear, and at least one planet carrier with at least one  
27 planet gear.

1           2. The power train of claim 1, wherein the driving  
2 shaft has a front end facing away from the transmission and the  
3 interactive rotary connection is arranged at said front end.

1           3. The power train of claim 1, wherein the interactive  
2 rotary connection comprises at least a pair of sheaves and an  
3 endless-loop device coupling the sheaves to each other by  
4 frictional contact.

1           4. The power train of claim 3, wherein each sheave  
2 comprises a belt-drive pulley and the endless-loop device  
3 comprises a belt.

1           5. The power train of claim 1, wherein the electro-  
2 mechanical energy converter serves as a starter motor for the  
3 combustion engine.

1           6. The power train of claim 1, wherein the electro-  
2 mechanical energy converter is used to propel the motor vehicle.

1           7. The power train of claim 1, wherein during a start-  
2 up phase of the combustion engine the second rpm rate is higher  
3 than the first rpm rate.

1           8. The power train of claim 1, wherein the rpm ratio  
2 for the first mode is smaller than the rpm ratio for the second  
3 mode.

1           9. The power train of claim 3, wherein the interactive  
2 rotary connection comprises a fixed-ratio rotary transfer stage  
3 formed by a belt drive with pulleys of different diameters.

4

1           10. The power train of claim 1, wherein the rotary  
2 transfer device comprises a housing and the at least one ring  
3 gear is connected and thereby rotationally coupled to the  
4 housing.

1           11. The power train of claim 1, wherein the at least  
2 one rotary transfer device further comprises a first clutch  
3 located in a first torque flow path that is operative under the  
4 first mode, and a second clutch located in a second torque flow  
5 path that is operative under the second mode, and wherein the  
6 first clutch is engaged in the first mode and disengaged in the  
7 second mode, while the second clutch is engaged in the second  
8 mode and disengaged in the first mode.

1           12. The power train of claim 11, wherein the first  
2 clutch and the second clutch are overrunning clutches.

1           13. The power train of claim 11, wherein the at least  
2 one rotary transfer device comprises a planetary gear mechanism  
3 with a ring gear, a sun gear, and a planet carrier with at least  
4 one planet gear, wherein under the first mode the electro-  
5 mechanical energy converter drives the sun gear which, in turn,  
6 drives the planet carrier through the at least one planet gear,  
7 and the planet carrier drives the combustion engine; and wherein  
8 under the second mode, the combustion engine drives the planet  
9 carrier with the at least one planet gear which, in turn, drives  
10 the electro-mechanical energy converter through the sun gear.

1           14. The power train of claim 11, wherein the at least  
2 one rotary transfer device comprises a first gear pair and a  
3 second gear pair, wherein under the first mode the electro-  
4 mechanical energy converter drives the combustion engine through  
5 the first clutch and the first gear pair; and wherein under the  
6 second mode, the combustion engine drives the electro-mechanical  
7 energy converter through the second clutch and the second gear  
8 pair.

1           15. The power train of claim 11, wherein the rotary  
2 transfer device has first transfer elements that determine the  
3 first rpm ratio and wherein the first clutch is placed in the

4 torque flow path at one of an upstream location and a downstream  
5 location relative to the first transfer elements.

1 16. The power train of claim 11, wherein the rotary  
2 transfer device has second transfer elements that determine the  
3 second rpm ratio and wherein the second clutch is placed in the  
4 torque flow path at one of an upstream location and a downstream  
5 location relative to the second transfer elements.

1 17. The power train of claim 1, wherein the interactive  
2 rotary connection comprises a rotary vibration damping device  
3 with energy-storing elements allowing the driving shaft and the  
4 energy converter shaft to rotate in relation to each other  
5 within a limited range against an opposing torque of the energy-  
6 storing elements.

1 18. The power train of claim 1, wherein the interactive  
2 rotary connection comprises a rotary shock/vibration absorbing  
3 device.

1 19. The power train of claim 3, wherein at least one of  
2 a rotary vibration damping device and a rotary shock/vibration  
3 absorbing device is arranged radially inside one of a belt-drive  
4 pulley and the rotor.

1 20. The power train of claim 1, wherein at least one of  
2 a rotary vibration damping device and a rotary shock/vibration

3 absorbing device is arranged on one of the driving shaft and the  
4 energy-converter shaft.

1           21. The power train of claim 1, wherein the ring gear,  
2 the planet gears, and the sun gear comprise a helical tooth  
3 profile; wherein under the first mode, the helical tooth profile  
4 pushes the ring gear in a first axial direction where the ring  
5 gear becomes locked to a non-rotating component; and wherein  
6 under the second mode, the helical tooth profile pushes the ring  
7 gear in a second axial direction where the ring gear becomes  
8 locked to the planet carrier.

1           22. The power train of claim 21, wherein the rotary  
2 transfer device has a ratio-locking means which, at rpm rates  
3 exceeding those required for the start-up mode, prevents the  
4 rotary transfer device from shifting out of a first rpm ratio  
5 that is normally reserved for the start-up mode.

1           23. The power train of claim 21, wherein the ratio-  
2 locking means comprises at least one centrifugal body arranged  
3 at an external circumference of the planet carrier, and wherein  
4 a centrifugal force drives the centrifugal body into form-  
5 locking engagement with a recess at an internal circumference of  
6 the ring gear.

1           24. The power train of claim 23, wherein the at least  
2 one centrifugal body has a spherical shape.

1           25. The power train of claim 21, wherein the ring gear  
2 has axially engaging coupler means for coupling the ring gear to  
3 one of the non-rotating component and the planet carrier.

1           26. The power train of claim 25, wherein the coupler  
2 means comprise at least one of a Hirth coupler, a dog clutch,  
3 and a friction clutch.